

I CLAIM:

1. An apparatus for rotatably hanging a tubing string in a well casing having a wellhead, the apparatus comprising:
  - 5 a tubing hanger shell having means for engagement with said wellhead;
  - 10 a mandrel rotatably mounted within said tubing hanger shell, said mandrel having an upper end and a lower end, said lower end having engagement means for connection to said tubing string and said upper end engaging coupling means which connects said mandrel to a tubing rotator, said coupling means providing means to transfer rotational energy from said tubing rotator to said mandrel while allowing for the disengagement of said tubing rotator from said mandrel through the application of force, and through movement,
    - 15 in a direction parallel to the longitudinal axis of said tubing string; and
  - 20 bearing means disposed between said tubing hanger shell and said mandrel to facilitate in the rotation of said mandrel within said tubing hanger shell.
2. The apparatus as claimed in claim 1 having sealing means disposed between said tubing hanger shell and said wellhead and between said tubing hanger shell and said mandrel.
3. The apparatus as claimed in claim 2 having further sealing means disposed
  - 25 between said mandrel and said coupling means.
4. The apparatus as claimed in claim 3 wherein said means on said tubing hanger shell for engagement with said wellhead comprises an inwardly tapered exterior

surface that frictionally engages an inwardly tapered shoulder in said wellhead.

5. The apparatus as claimed in claim 4 wherein said sealing means and said frictional engagement of said tubing hanger shell with said wellhead prevent fluid leakage from between said wellhead and said tubing string.

6. The apparatus as claimed in claims 1 or 5 wherein said engagement means on said lower end of said mandrel comprises a threaded portion on said mandrel for accepting a correspondingly threaded portion on said tubing string.

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7. The apparatus as claimed in claim 6 wherein said mandrel includes an internal tubing string pick-up thread.

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8. The apparatus as claimed in claim 7 wherein the disengagement of said tubing rotator from said mandrel is accomplished without appreciable rotational movement.

9. The apparatus as claimed in claim 8 wherein said sealing means are O-rings.

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10. The apparatus as claimed in claim 1 wherein said bearing means comprises thrust bearings to facilitate the rotational movement of said mandrel when said mandrel is subjected to vertical loading.

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11. The apparatus as claimed in claim 10 wherein said bearing means further comprises radial bearings to facilitate the rotational movement of said mandrel when said wellhead and said well casing are inclined and said mandrel is subjected to non-vertical loading.

12. The apparatus as claimed in claim 1 wherein said coupling means comprises a hollow sleeve threaded onto a rotor shaft of said tubing rotator, said hollow sleeve on said rotor shaft being received within said mandrel when said tubing rotator is connected to said mandrel.

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13. The apparatus as claimed in claim 12 wherein said hollow sleeve includes longitudinal splines which engage corresponding longitudinal splines on said mandrel, said rotational energy transferred from said tubing rotator to said mandrel through said engagement of said splines.

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14. The apparatus as claimed in claim 13 wherein the disengagement of said tubing rotator from said mandrel is accomplished through the disengagement of said splines on said hollow sleeve from said splines on said mandrel and without appreciable rotational movement.

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15. The apparatus as claimed in claim 14 wherein said splines on said mandrel and on said hollow sleeve are involute.

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16. The apparatus as claimed in claim 1 including retaining means engageable with said tubing hanger shell to retain said mandrel within said tubing hanger shell.

17. The apparatus as claimed in claim 16 wherein said retaining means is a retaining nut.

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18. The apparatus as claimed in claim 17 wherein said retaining nut includes a keyway, said keyway aligning with a corresponding keyway in said mandrel when said retaining nut is engaged with said tubing hanger shell, said keyway in said retaining nut and said keyway in said mandrel providing means for the insertion of

a key therein to prevent rotation of said mandrel within said tubing hanger shell.

19. The apparatus as claimed in claim 17 having a plurality of keyways in said retaining nut and in said mandrel, said keyways in said retaining nut and in said mandrel aligning when said retaining nut is engaged with said tubing hanger shell, said keyways in said retaining nut and said keyways in said mandrel providing means for the insertion of a plurality of keys therein to prevent rotation of said mandrel within said tubing hanger shell.

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10 20. The apparatus as claimed in claim 1 wherein said mandrel includes an internal tubing string pick-up thread.

21. An apparatus for rotatably hanging a tubing string in a well casing having a wellhead, the apparatus comprising:

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a tubing hanger shell having means for engagement with said wellhead;

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a mandrel rotatably mounted within said tubing hanger shell, said mandrel having an internal tubing string pick-up thread and having an upper end and a lower end, said lower end having engagement means for connection to said tubing string;

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coupling means engaging said upper end of said mandrel and connecting said mandrel to a tubing rotator, said coupling means comprising a hollow sleeve threaded onto a rotor shaft of said tubing rotator and being received within said mandrel when said tubing rotator is connected to said mandrel, said hollow sleeve providing means to transfer rotational energy from said tubing rotator to said mandrel while allowing for the disengagement of said tubing

rotator from said mandrel through the application of force, and through movement, in a direction parallel to the longitudinal axis of said tubing string;

5           sealing means disposed between said tubing hanger shell and said wellhead, between said tubing hanger shell and said mandrel, and between said mandrel and said coupling means; and,

bearing means disposed between said tubing hanger shell and said mandrel to facilitate in the rotation of said mandrel within said tubing hanger shell.

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22. An apparatus for rotatably hanging a tubing string in a well casing having a wellhead, the apparatus comprising:

a tubing hanger shell having means for engagement with said wellhead;

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a mandrel rotatably mounted within said tubing hanger shell, said mandrel having an upper end and a lower end, said lower end having engagement means for connection to said tubing string and said upper end having a series of longitudinally oriented splines that engage corresponding splines on a shaft of a tubing rotator connected thereto, said splines on said mandrel and on said tubing rotator providing means to transfer rotational energy from said tubing rotator to said mandrel while allowing for the disengagement of said tubing rotator from said mandrel through the application of force, and through movement, in a direction parallel to the longitudinal axis of said tubing string;

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and,

bearing means disposed between said tubing hanger shell and said mandrel to facilitate in the rotational movement of said mandrel within said tubing hanger

shell.

23. The apparatus as claimed in claim 22 having sealing means disposed between said tubing hanger shell and said wellhead, and between said tubing hanger shell and  
5 said mandrel.

24. The apparatus as claimed in claim 23 including a retaining nut engageable with said tubing hanger shell to retain said mandrel within said tubing hanger shell.

10 25. The apparatus as claimed in claim 24 wherein said mandrel includes an internal tubing string pick-up thread.

26. An apparatus for rotatably hanging a tubing string in a well casing having a wellhead, the apparatus comprising:

15 a tubing hanger shell for hanging said tubing string in said well casing, said tubing hanger shell having means for engagement with said wellhead;

20 25 a mandrel rotatably mounted within said tubing hanger shell, said mandrel having an upper end and a lower end, said lower end having engagement means for connection to said tubing string and said upper end engaging coupling means for connection to a tubing rotator, said coupling means providing means to transfer rotational energy from said tubing rotator to said mandrel and allowing for the disengagement of said tubing rotator from said mandrel without appreciable rotational movement; and,

bearing means disposed between said tubing hanger shell and said mandrel to facilitate in the rotation of said mandrel within said tubing hanger shell.

27. The apparatus as claimed in claim 26 having sealing means disposed between said tubing hanger shell and said wellhead, between said tubing hanger shell and said mandrel, and between said mandrel and said coupling means.

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28. The apparatus as claimed in claim 27 wherein said mandrel includes an internal tubing string pick-up thread.